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(54) A process for manufacturing colored contact lenses, and the lenses obtained by the process.

(57) A process for manufacturing colored contact lenses, and the lenses obtained by the process, based essentially in the discovery that it is possible to apply the colorant (or color layers) to the convex or concave face of the manufacturing mold in such a way that the desired iris imprint is later infiltrated into the lens till final embodiment next to the selected surface. The resulting cosmetic contact lens has a transparent pupil section and a colored annular region whose structure, covering entirely the user's iris, conceals it partially by means of a screen that contours conveniently the visible pigmented layers of the human iris, chromatically intermingling with the pattern of said iris. This lens is capable of modifying the perceptible iris color of the user, while retaining a natural appearance, even under almost near vision onlooker gaze.

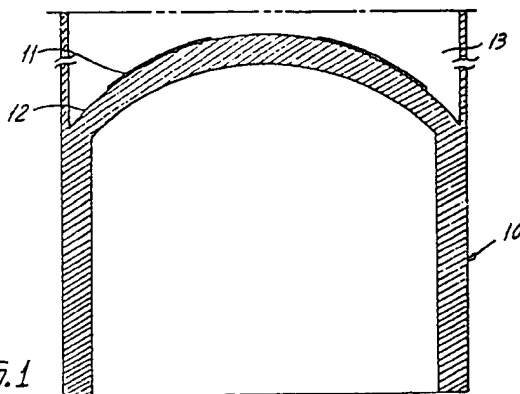


FIG. 1

EP 0 357 062 A2

# A PROCESS FOR MANUFACTURING COLORED CONTACT LENSES, AND THE LENSES OBTAINED BY THE PROCESS

## BACKGROUND

It is well known to those versed in the art that cosmetic contact lens, capable of changing or masking totally or partially the color of the iris, have been manufactured with a limited degree of success, for several reasons. For example, those which contain a tint throughout the body of the lens, or the portion corresponding to the iris, because they cannot cause a fundamental color change. The preliminary art related to the manufacture of colored contact lenses that include a zone or pattern covering the iris of the user it is also associated with a relevant bibliography; for example:

- Wichterle, in U.S. Patent 3.679.304, of July 1972, discloses contact lenses with an opaque colored solid pattern (sandwiched between two layers of polymer) covering the iris entirely, that are able to change its color, although with unnatural results.

- Urbach, in U.S. Patent Des. 211.751, dated July 23, 1968 discloses a design for contact lenses having a dot-matrix pattern covering the outer portion of the iris, in the shape of a regular ring, whose effects are rather ornamental than chromatic.

- Le Grand, in U.S. Patent 3.712.718, dated Jan 23, 1973, teaches contact lenses having iris patterns penetrating the entire thickness of the lens, that are not intended to cover the entire iris section or to change its color, but to highlight the same.

- Knapp, in U.S. Patents 4.582.402; 4.704.017; and 4.720.188 discloses contact lenses having a colored, opaque or translucent, intermittent pattern deposited over the surface of the entire iris section to attain a coloring effects. The pattern is composed of dots and transparent interstices in several ratios, to allow visualization of the iris structure, obtaining a noticeable color change when observed by the ordinary viewer (i.e. a person having 20/20 vision at five feet). While these lenses are capable of such color change, the result ceases to be natural as the viewer transposes the five feet barrier or is allowed vision at an angle, as dots fail to mimic completely the iris structure, and being deposited on the surface of the lens, are unable to reproduce the color with the depth perception caused by the corneal layer.

Moreover, the color coating associated with offset pad printing on the surface of the lens is, of course, exposed to the ocular fluids, to which it may be described as only resistant.

- Pfortner has presented applications of Argentine Patents Nrs. 301.045, 308.046, 308.047, 309.706,

teaching different types of cosmetic soft contact lenses making use of the offset pad printing method (first applied in Germany during the early 1970's), where the colorants, either totally or partially concealing the user's iris with any desired pattern, may be sandwiched in the lens or deposited on its surface depending on the targeted final thickness. Sandwiched types are costly to produce and those impregnated on top by patented methods share virtues and flaws with Knapp's models.

## SUMMARY OF THE INVENTION

The present invention is based upon the discovery that any desired colored iris lens design, printed by means of the well known technique of offset pad, on the convex or concave face of a contact lens manufacturing mold, may later be infiltrated into the lens till final embodiment next to the posterior or anterior surface. As it is common in the art, the cosmetic contact lens obtained by this invention has normally a transparent pupil section and a colored annular region, whose structure, covering entirely the user's iris, conceals it partially by means of a screen that conveniently contouring the visible pigmented layers of the human iris, is made up of minute opaque, translucent and clear portions that chromatically intermingle with the pattern of said iris.

The color contact lens obtained with the procedure of the present invention is capable of modifying the perceptible iris color of the user within a wide range of possibilities, while retaining a natural appearance, because the colorants are not on the surface of the lens, but embodied next to its posterior or anterior face, so that inciding light beams are refracted by the transparent material covering them, situation that closely resembles the optical interaction occurring between the human iris and the cornea. Moreover, this striking effect is enhanced by the natural screen configuration, which accompanying the design of the anterior layers of the human iris modifies the color perceived by each observer, allowing closer onlooker gaze than lenses printed on the front surface. It is the main object of the present invention a process for preparing colored contact lenses by "cast base curve molding", either with supporting mold or "bonnet", or by cast molding, comprising taking a convex or concave plastic mold and eventually recovering its surface with one or more layers of the lens material, by means of an offset printing pad with a

blank plate, drying the imprint at a temperature no higher than 80° C, and then depositing the colorant directly on the mold by offset pad printing, using a photomechanically engraved plate with an adequate design of human iris, subjecting the mold to a temperature no higher than 80° C, filling the mold with the lens material; polymerizing the resulting blank or bonnet and finishing it by lathe to obtain a contact lens with a transparent pupil section and a colored annular region whose structure, covering entirely the user's iris, conceals it partially by means of a screen that, conveniently contouring the pigmented anterior layers of the human iris, is made up of minute opaque, translucent and transparent portions that chromatically intermingle with the pattern of said iris, whereby resulting in a cosmetic contact lens capable of modifying the perceptible iris color of user, that retains a natural appearance, even under almost near vision onlooker gaze.

It is still another object of said invention, as an article of manufacture, a contact lens capable of modifying the perceptible iris color of user, which is obtained with the process according to claims 1 and 2, characterized in that said annular region is built in the body of the lens, close to its posterior surface, so that it masks partially said iris by means of a screen that conveniently contouring the pigmented visible layers of the human iris, chromatically intermingles with its design, so determining a change in the perceptible iris color of use, that retains a natural appearance, even under almost near vision onlooker gaze.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional view of the manufacturing mold (10) where an enlarged imprint of colorant (11) has already being deposited on its convex face (12).

Fig. 2 is a sectional view of the intermediate blank obtained by cast base molding after casting of lens prepolymer; (14) indicates the casting level. Said fig. 2 shows previous imprint (11) already separated from mold face (12) due to migration to the body of casting mass, until final incorporation at some distance from mold surface (12).

Fig. 3 is a sectional view of totally finished cosmetic contact lens (15), including color offset imprint (11) built in the body of the lens (15), after polymerization of pre-polymer and conventional latheing of material (16).

Fig. 4 shows a "bonnet" obtained by cast base curve molding, according to the process of the present invention.

Fig. 5 shows a sectional view of a cosmetic

contact lens obtained by "cast molding", according to a variation of the process, where the color imprint (11) is deposited either in the concave or convex molding face. Here the mold (10) comprises a concave molding surface (17) and a convex one (18), corresponding to forming piece (19).

#### DETAILED DESCRIPTION OF THE INVENTION

The present invention makes it possible to produce economically colored contact lenses whose pigments and the corresponding iris design are incorporated within the lens body, thus proposing the best cosmetic result with a remarkable protection of ocular tissues.

It is also to be noted that the lenses obtained with the process of the present invention allow a convenient masking of the anterior layers of the human iris, by making use of photomechanic reproductions of the desired pattern that will always retain naturally balanced proportions of opaque translucent and clear colored parts, to intermingle with the underlying user's iris.

While the standard procedure will call for use of one plate depicting a screen with a single color, it is also possible to employ several colors with the same plate, or different ones, in successive printing stages, until the desired visual effect is achieved.

As colored contact lenses obtained by the process of the present invention are conceived as such from the initial stages of their production it is necessary to start with the manufacturing molds.

In a method for manufacturing cast base curve molding transparent contact lenses (either with supporting mold or "bonnet"), the process is as follows:

- A convex plastic manufacturing mold, perfectly clean, is provided.
- Said mold is firmly fitted to the offset pad printing machine well known in the art.
- Meanwhile, a plate depicting an iris pattern compatible with the desired degree of masking, has been engraved, for example, by photomechanic reproduction.
- Said plate is firmly secured to the printing machine, and one or more impressions of the annular iris design are deposited on the surface of the mold.
- The mold is then withdrawn from the printing machine and put in an oven, for an overnight thermal treatment at a temperature not exceeding 80° C.
- Following this stage the mold, bearing the corresponding iris imprint, resumes the regular cast base curve molding manufacturing process for transparent contact lenses, that is to say, it is in conditions for casting the corresponding lens ma-

terial, which can be hard, soft or gas permeable.

- Once the mold is filled and the pertaining polymerization is concluded, the colored blank is ready; if it is demolded it will be seen that the iris imprint has been transferred from the mold to the body of the future contact lens, next to its posterior finished surface.

- The front surface of the colored lens is finally obtained by lathing and polishing, as with any regular transparent contact lens produced by the cast base molding method.

This same offset pad printing process may be used to color contact lenses obtained by the cast molding manufacturing method by printing the iris either on the concave or convex mold.

Preferred colorants for both processes, comprising pigments and binders, are those described in Argentine patents applications Nrs. 308.047, 309.706 cited here by way of reference.

Although incorporation of the iris imprint within the body of the lens is in both cases complete, further encapsulation of the same may be obtained by pre-coating the manufacturing mold convex or concave surface with one or more layers of the lens material, using the offset pad printing machine with a blank annular plate, allowing at least one hour drying period at 80° C, prior to the color coating formerly mentioned.

Even though the present invention has been described in certain detail by way of illustrations and general examples for purpose of comprehension, it is understood that minor changes and modifications may be introduced without deviating from its original spirit and scope, that imply clear advantages over prior art techniques:

1. Ideal incorporation of pigments into the body of the lens, thus ensuring ocular tissue safety and unfading cosmetic effect during the lens' lifespan.

2. More natural appearance than lenses printed on the surface, without increasing its thickness.

## Claims

1. Process for manufacturing colored contact lenses by "cast base curve molding", either with supporting mold or "bonnet", or by "cast molding", comprising providing a convex or concave plastic mold, and eventually recovering its surface with one or more layers of the lens material, by offset pad printing with a blank annular plate, drying the imprint at a temperature no higher than 80° C and then depositing colorant directly on the mold by offset pad printing, using a photomechanically engraved plate with an adequate design of the human iris, subjecting the mold to a temperature no

higher than 80° C, filling the mold with the lens material, polymerizing the resulting blank or bonnet and finishing it by lathing and polishing, to obtain a contact lens with a transparent pupil section and a colored annular region whose structure, covering entirely the user's iris, conceals it partially by means of a screen which conveniently contouring the pigmented visible layers of the human iris, is made up of minute opaque, translucent and transparent portions that chromatically intermingle with the pattern of said iris, whereby resulting in a cosmetic contact lens capable of modifying the perceptible iris color of the user, while retaining a natural appearance, even under almost near vision onlooker gaze.

2. A process as set forth in claim 1, wherein the manufacturing method is cast molding, thus obtaining a finished cosmetic contact lens, without further lathing, by printing the iris either on the concave or convex manufacturing mold.

3. The process of claim 1, wherein the lens is obtained from hydrophilic materials.

4. The process of claim 1, wherein the lens is obtained from PMMA.

5. The process of claim 1, wherein the lens is obtained from gas permeable materials.

6. The process of claim 2, wherein the lens is obtained from hydrophilic materials.

7. The process of claim 2, wherein the lens is obtained from PMMA.

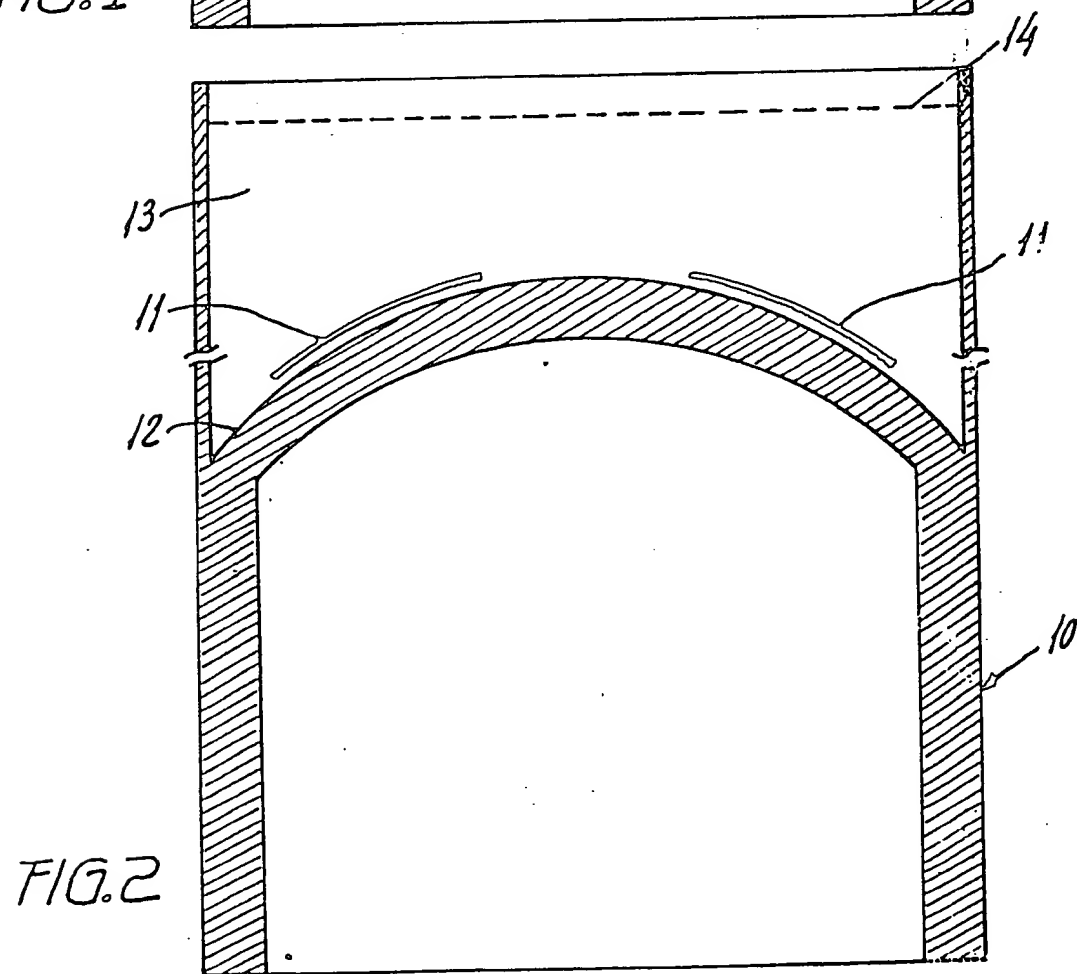
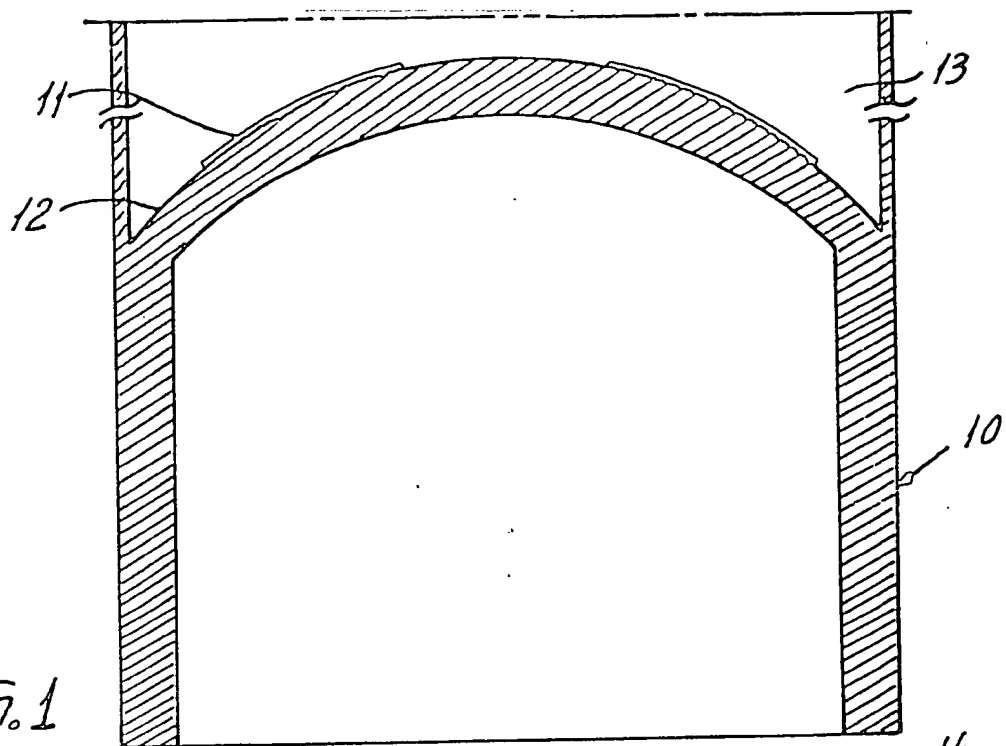
8. The process of claim 2, wherein the lens is obtained from gas permeable materials.

9. As an article of manufacture, a contact lens capable of modifying the perceptible iris color of the lens user, whose colored annular region, obtained as described in claims 1 and 2, and covering entirely the user's iris, is incorporated in the body of the lens, next to its posterior or anterior surface, so as to conceal partially said iris by means of a screen which conveniently contouring the colored visible layers of the human iris, chromatically intermingle with its pattern, thus resulting in a change of the perceptible iris color of the wearer, while retaining a natural appearance, even under almost near vision onlooker gaze.

10. The contact lens of claim 9, manufactured from hydrophilic materials.

11. The contact lens of claim 9, manufactured from PMMA.

12. The contact lens of claim 9, manufactured from gas permeable materials.



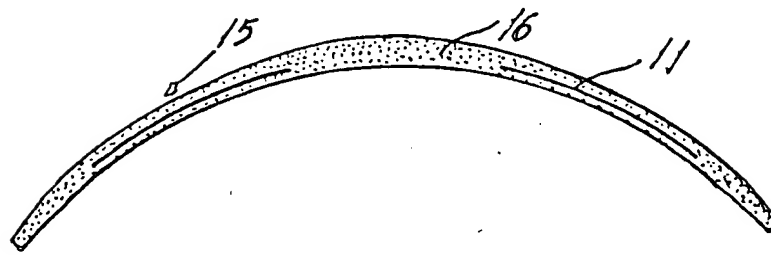


FIG. 3

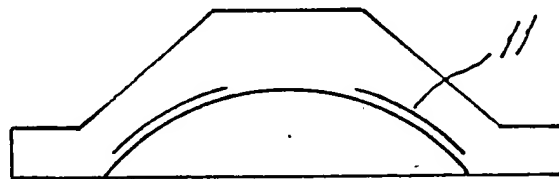


FIG. 4

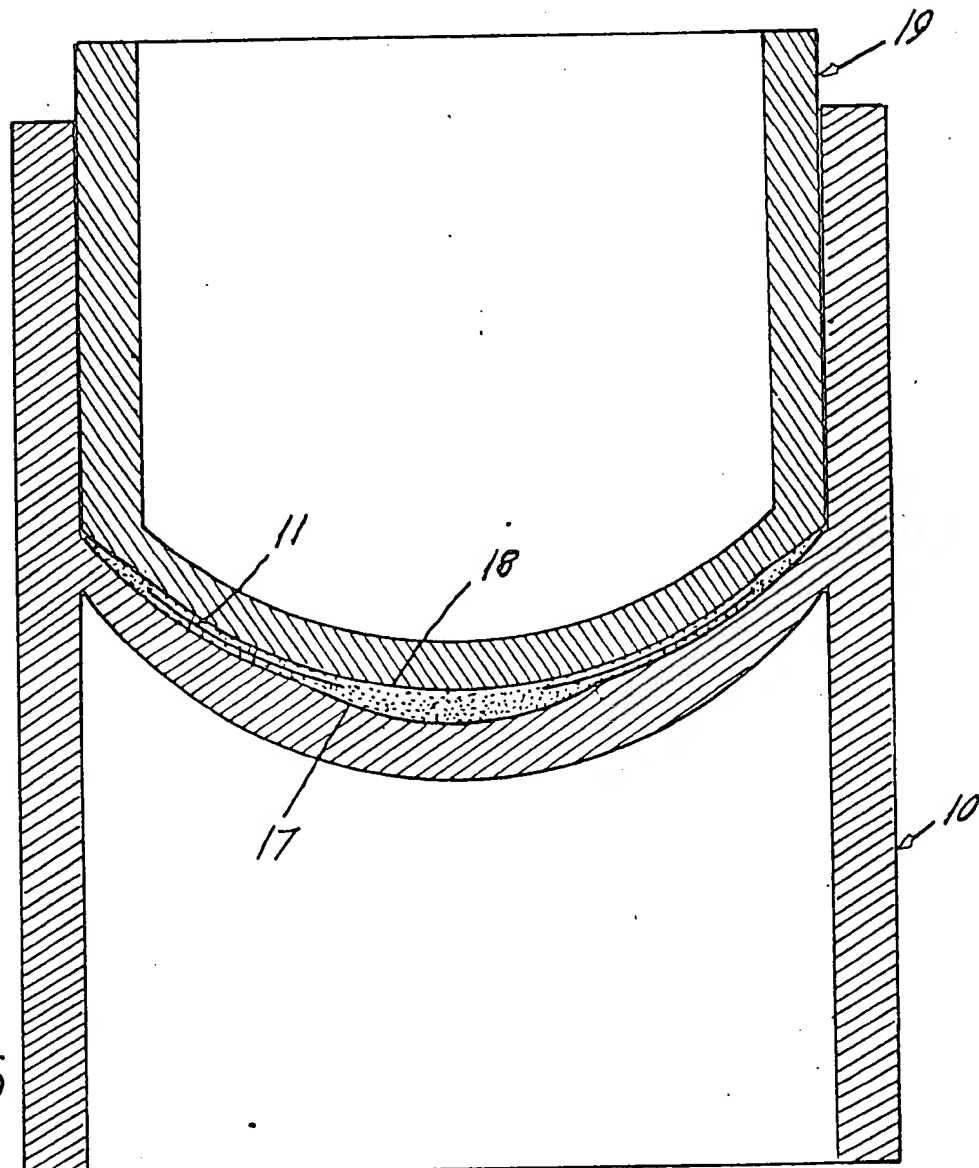


FIG. 5

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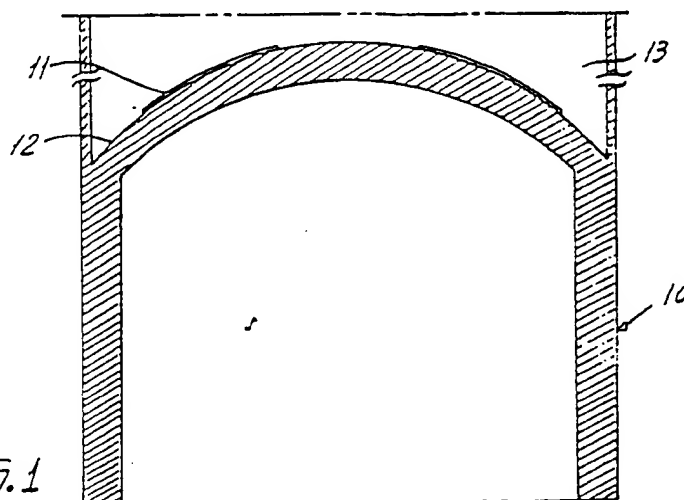


FIG. 1

EP 0 357 062 A3



DOCUMENTS CONSIDERED TO BE RELEVANT															
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)												
X	US-A-4 640 805 (NEEFE) * Column 2, lines 54-58; column 3, lines 12-16,25-30; figures 2,4 * -----	1-12	B 29 D 11/00												
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)												
			B 29 D G 02 C												
The present search report has been drawn up for all claims															
Place of search THE HAGUE		Date of completion of the search 05-06-1990	Examiner ATTALLA G.												
<table border="0"><tr><td><b>CATEGORY OF CITED DOCUMENTS</b></td><td><b>T : theory or principle underlying the invention</b></td></tr><tr><td>X : particularly relevant if taken alone</td><td>E : earlier patent document, but published on, or after the filing date</td></tr><tr><td>Y : particularly relevant if combined with another document of the same category</td><td>D : document cited in the application</td></tr><tr><td>A : technological background</td><td>L : document cited for other reasons</td></tr><tr><td>O : non-written disclosure</td><td>&amp; : member of the same patent family, corresponding document</td></tr><tr><td>P : intermediate document</td><td></td></tr></table>				<b>CATEGORY OF CITED DOCUMENTS</b>	<b>T : theory or principle underlying the invention</b>	X : particularly relevant if taken alone	E : earlier patent document, but published on, or after the filing date	Y : particularly relevant if combined with another document of the same category	D : document cited in the application	A : technological background	L : document cited for other reasons	O : non-written disclosure	& : member of the same patent family, corresponding document	P : intermediate document	
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